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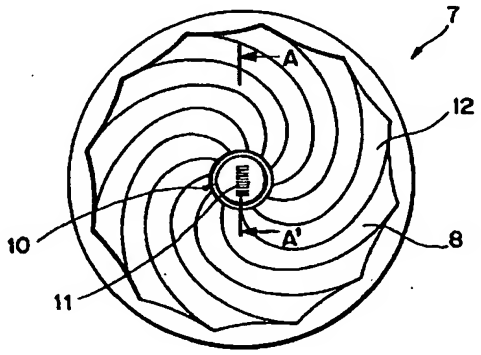
(54) Reflecting mirror for floodlight

(57) An improved reflective mirror for floodlights that diffuses and reflects a beam of light from a light source in uniform brightness in a given floodlight area is provided. A concave reflecting mirror (7) is provided with an aperture (9) at the axis center (K) of the mirror for inserting a light source (10) such as a bulb, so that the inner periphery of the reflecting mirror is on the side and behind the light source. A plurality of reflectors (12) are formed in the inner periphery (8) of the reflecting mirror in a spiral profile when viewed from the front. The reflectors (12) spiral out from the axis center (K) of the reflecting mirror. Each of the reflectors (12) has a convex (12A) or concave (13A) profile surface, so that a cross section of the reflective mirror inner periphery surface appears to be ribbed.

FIG. 3



EP 0 915 287 A2

Description

Background of Invention

[0001] The present invention comprises an improved reflecting mirror for spotlights. Conventional reflecting mirrors for spotlights are well known in the art. As shown in Figure 1, these mirrors generally comprise a parabolic shaped dish with a reflective inner surface (1) and an aperture in the axial center through which a light source protrudes. The light source can be an incandescent lamp (3) which emits light when a filament (2) is energized with current. The reflective inner surface of the parabolic shaped dish reflects light from the light source in the forward direction, thereby efficiently illuminating the object.

[0002] In this general configuration of a floodlight reflecting mirror, the reflected illuminated light can have uneven brightness. This results from an unevenness in the light emission from the filament source. In extreme cases, a magnified image of the filament may be projected.

[0003] To address this problem, reflective mirrors have been developed with a plurality of small approximately round reflective spots on the inner periphery of the mirror, each individual spot with either a concave or convex surface. This configuration is designed to diffuse the reflected light so that more evenly diffused lighting is achieved. Although this configuration may improve the evenness of illuminated light, the process of creating and manufacturing such a reflective parabolic mirror is very difficult.

[0004] Another reflective mirror configuration designed to solve the problem of uneven reflected light is shown in Figure 2. In this configuration, the reflective mirror inner periphery (4) is subdivided into a plurality of expanding annular rings (5) with their center at the reflective mirror axial center with a protruding incandescent lamp (6). Each of these annular rings has a convex surface, so that the reflected light will diffuse and be distributed more evenly. With this configuration uneven shading of the filament in the direction of the optic axis of the incandescent lamp (6) is diffused and brightness is made uniform by the reflection on the surface of the annular rings. The unevenness of the filament in the circumferential direction that exists in the orthogonal plane to the optical axis cannot be diffused.

[0005] Therefore an unresolved need exists in industry for an effective and economically feasible floodlight reflective mirror.

Object of the Invention

[0006] It is an object of the present invention to provide an improved spotlight reflective mirror that can equalize and evenly diffuse both the unevenness of a filament light source located in the direction of the light axis of the light source and the unevenness in shading of the filament located in the orthogonal direction to the direction of the light axis of the light source, and that can thereby reflect evenly illuminated light in a given floodlight area.

Brief Description of the Drawings

[0007] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and , together with the description, serve to explain the principles of the invention.

Figure 1 shows a typical spotlight reflective mirror with light bulb;
Figure 2 shows a prior art configuration;
Figure 3 shows a front view of an embodiment of the present invention;
Figure 4 shows a cross section of an embodiment of the present invention;
Figure 5 diagrams light reflection patterns for an embodiment of the present invention;
Figure 6 diagrams light reflection patterns for an embodiment of the present invention; and
Figure 7 shows a cross section of an embodiment of the present invention.
Figures 8A to 8C show a further alternate embodiment of the present invention.
Figure 9 shows operation and effects of the embodiment.
Figure 10 shows a definition of width of stripes according to the embodiment.
Figures 11A and 11B show variations of mounting a light source.

Summary of the Invention

[0008] The present invention comprises an improved reflecting mirror for spotlights.

[0009] The present invention comprises a parabolic shaped reflective mirror with a reflective inner periphery surface. According to one aspect of the invention, the mirror has an aperture near its center through which a light source, such as a light bulb, may protrude. When the light source is inserted through the reflective mirror's center aperture, the reflective inner surface of the mirror will reflect the light from the light source forward, thereby focusing the light towards a desired area.

[0010] The inner reflective surface of the present invention has a concave-convex pattern which diffuses light from the light source in a radial direction from the reflective mirror center and in a circumferential direction around the center.

[0011] According to the preferred aspect of the invention, the inner reflective surface of the present invention comprises a plurality of reflectors which when viewed from the front spiral outward from the reflective mirror center. Each of these spiraling reflectors has either a

convex or concave surface, so that a cross sectional view of the reflective surface has ribs. The convex or concave surface of the spiraling reflectors allows for evenly diffused light along the axis of the reflective mirror bulb. Also, because the spiraled shape, the reflected light is also evenly diffused along the axis perpendicular to the reflective mirror bulb. Thus uneven light emanating from an unevenly illuminated filament in the direction of the whole circumference that exists in the orthogonal plane to the optical axis can be diffused.

[0012] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

Detailed Description of Embodiments

[0013] Figure 3 shows a front view of a preferred embodiment of the present invention, while Figure 4 shows a profile view of the same embodiment. A floodlight (7) has a parabolic shape, with reflective mirror with reflective inner surface (8). A bulb insertion hole (9) is formed at the axis center of the reflective mirror. An incandescent lamp (10) is inserted through the bulb insertion hole (9) as a light source such that the inner periphery (8) is at the side or back of the bulb. The incandescent bulb has a built in filament (11).

[0014] As shown in Figure 3, a plurality of reflectors (12) configured in a spiraling effect, when viewed from the front, are formed on the inner periphery (8) of the mirror. These reflectors spiral out from and around the axis center of the reflective mirror. As shown in Figure 4, each of these spiraling reflectors in this preferred embodiment of the invention has a convex surface (12A) so that a cross sectional view of the reflective surface reveals a ribbed structure. The reflective mirror in this preferred embodiment is constructed of injection molded plastic, with aluminum vapor deposited on the reflective surface.

[0015] As shown in Figure 4, the basic shape of this preferred embodiment is a revolving paraboloid, with a focal distance of 13.1 mm, an effective outside diameter of 75 mm and an effective inside diameter of 22 m. The reflective mirror is finely divided into 60 strips, each 1 mm wide, in a multiple spiral profile, with each strip reflecting surface (12A) in a convex circle profile with 1 mm width and a cross sectional curvature of 30 mm.

[0016] The aforementioned dimensions are provided as examples. They will change based on conditions of light diffusion (specification of the product). Figure 10 shows an another example of dimensions. An effective outside diameter A is 52 mm, an effective depth B is 28 mm, a width of stripe P is 0.85 mm, and a cross sectional curvature of each stripe is 29.5 mm. Note that the width of each stripe is determined by the width of each stripe projected on an orthogonal plane to the light axis, as shown in Figure 10. Preferably, all widths of the stripes are the same.

[0017] As shown in Figure 5, when the incandescent lamp (10) is turned on, a beam of light from the light emission point X1 of the filament (11) will travel along the path defined by the solid lines and run into the reflecting surface (12A) of the reflector (12), with the result that the reflected beam of light is diffused at a given average angle θ_1 and irradiated to the front of the reflecting mirror for floodlight 7.

[0018] Also, if there exits another light emission point, such as X2 in Figure 5 at the location on the light axis K, that is of a different strength than the light emission point X1, the beam of light from X2 will travel along the path shown defined by the broken lines in Figure 5, and will be diffused by the reflector at a given average angle θ_1, with the result that evenly diffused reflected lighting is achieved.

[0019] Figure 6 shows that the orthogonal cross section to the light axis K shows that the reflector (12) of the reflecting mirror for floodlight (7) is made as circle type of reflecting surface (12A). Therefore, when a beam of light from the light emitting point Y1 travels along the path defined by the solid lines runs into this reflecting surface 12A, the beam is diffused in the circumferential direction of within the range of an average angle θ_2 and irradiated forward of the reflecting mirror for floodlight 7.

[0020] If there should exist another light emitting point Y2 on the same orthogonal plane to the axis of light K of the light emitting point Y1, the beam of emitted light from point Y2 will travel along the path defined by the broken line. This beam will be reflected at an average angle of θ_2, thereby evening out the irradiated light from the luminating points Y1 and Y2.

[0021] In this manner unevenness of the illuminated light can be prevented even using an unevenly lit filament bulb. The dimensions given above for this preferred embodiment of the invention will result in uniform floodlight being provided in an area 250 mm in diameter at a distance of 2 m from the front of the reflecting mirror.

[0022] The operation and effects of the above embodiment will be further discussed with reference to Figure 9. In Figure 9, a-1 to a-3 show projected light patterns and diffusion state of light flux in the case where a reflecting mirror with a smooth surface, as shown in Figure 1, is used. The light flux does not diffuse (spread) very much (see a-3). As a result, dark portion appears in the center of the projected light pattern (see a-2) and shadows of filament legs appear in the light pattern (see a-2).

[0023] Figure 9, b-1 to b-3 show projected light pattern and diffusion state of light flux (light beam) in a case where the reflecting mirror shown in Figure 2 is used. As shown in b-3, the light flux diffuses in the radial direction. However, the light flux does not diffuse evenly along the circumference (as discussed in the background of the invention). Although the dark portion near the center of the projected light pattern disappears, the

shadow of the filament legs remains as shown in b-2.

[0024] Figure 9, c-1 to c-3 show projected light pattern and diffusion state of light flux in a case where the reflecting mirror of the embodiment (shown in Figures 3 - 6) is used. As shown in c-3, the light flux diffuses in a radial direction (as explained with reference to Figure 5), and in a circumferential direction (as explained with reference to Figure 6). By virtue of these diffusion patterns of light, shadow of filament legs disappear in a projected light as shown in c-2, and uniform projection of light is achieved.

[0025] Figure 7 shows an alternate embodiment of the invention. A plurality of reflectors (12) are formed in a spiral form, when viewed from the front, on the inner periphery (8) of the reflecting mirror for floodlight (7) starting at the axis center of the inner periphery (8). Each reflector (12) has a reflecting surface (13A) formed in a concave circle profile, with the result that a cross sectional view of the inner periphery surface is ribbed.

[0026] The other structures, operations and effects are the same as those of the first embodiment.

[0027] Figure 8A to 8C show another alternative embodiment. In this embodiment, radial (diameter) direction stripes and concentric annular ring stripes are formed on the reflective mirror. As shown in Figures 8B and 8C, this structure has similar sectional view to Figures 5 and 6 (Figure 8B corresponds to Figure 6, Figure 8C corresponds to Figure 5). More specifically, a plurality of portions are delimited on the reflecting surface by the radial direction stripes and concentric annular ring stripes. Each of the stripes has a reflecting surface formed in a convex circle profile. Therefore, each of the plurality of portions has a convex cross sectional shape. Accordingly, light from a light source will be diffused in a radial direction and a circumferential direction, and uniform light projection can be achieved as explained above.

[0028] Note that, although Figures 8B and 8C show that each portion has a reflecting surface formed in a convex profile, each reflector may have a reflecting surface formed in a concave profile as explained with reference to Figure 7.

[0029] Note that the reflection mirror in the above embodiments is constructed of injection molded plastic. However, the reflecting mirror may be manufactured in the other processes.

[0030] In the above embodiments, reflecting mirror which is applied to a handy floodlight is explained. However, it is apparent that the reflector of the present invention can be applied for the other types of light device.

[0031] According to the above embodiments, light source is mounted through the aperture near the center of the reflection mirror. However, it will be apparent to a person skilled in the art that the present invention can be applied to a case where light source is mounted in front of the mirror without aperture in the reflection mirror as shown in Figure 11A, a case where light source is mounted through an aperture located on a side of the reflection mirror as shown in Figure 11B.

[0032] As described above, the reflector according to the present invention can correct unevenness caused by uneven luminous of a filament along both a light axis and a orthogonal axis to the light axis. Accordingly, the present invention can diffuse a light from a light source within a predetermined extent.

[0033] As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the claims.

[0034] An improved reflective mirror for floodlights that diffuses and reflects a beam of light from a light source in uniform brightness in a given floodlight area is provided. A concave reflecting mirror is provided with an aperture at the axis center of the mirror for inserting a light source such as a bulb, so that the inner periphery of the reflecting mirror is on the side and behind the light source. A plurality of reflectors are formed in the inner periphery of the reflecting mirror in a spiral profile when viewed from the front. The reflectors spiral out from the axis center of the reflecting mirror. Each of the reflectors has a convex or concave profile surface, so that a cross section of the reflective mirror inner periphery surface appears to be ribbed.

Claims

1. A reflector for a light source comprising,

   concave reflecting mirror having a reflecting surface,
   characterized in that said reflecting surface having a concave-convex pattern which diffuses light generated by the light source in a radial direction outward from a center of the reflecting mirror and a circumferential direction around the center.

2. The reflector for a light source according to claim 1, wherein said reflecting surface is subdivided into a plurality of reflectors, and said reflectors comprise ribs spiraling outward from and rotating around the center.

3. The reflector for a light sources according to claim 2, wherein said spiraling reflectors each have a convex surface between adjacent ribs.

4. The reflector for a light source according to claim 2, wherein said spiraling reflectors each have a concave surface between adjacent ribs.

5. The reflector for a light source according to claim 2,

wherein said ribs have a constant width, said width being determined by a width of a ribs projected on an orthogonal plain to a light axis direction of the reflector.

6. The reflector for a light source according to claim 1, wherein said reflecting surface consists of concentric stripes, inner stripes having smaller circumference than outer stripes, and radial stripes outward from the center, each portion delimited by the radial and concentric stripes having a convex cross sectional shape.

7. The reflector for a light source according to claim 1, wherein said reflecting surface consists of concentric stripes, inner stripes having smaller circumference than outer stripes, and radial stripes outward from the center, each portion delimited by the radial and concentric stripes having a concave cross sectional shape.

8. The reflector for a light source according to any one of preceding claims, wherein said reflecting mirror has an aperture near its center through which the light source protrudes.

FIG. 1

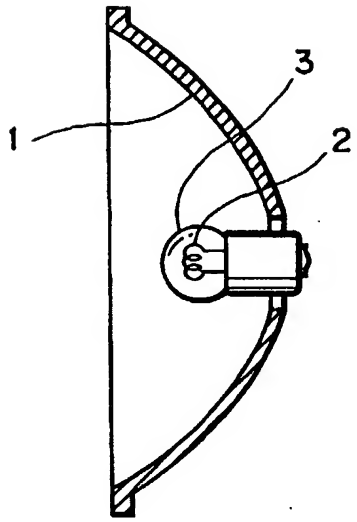


FIG. 2

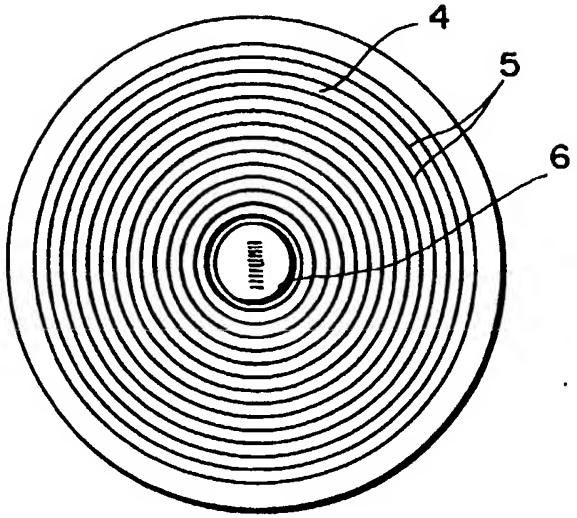


FIG. 3

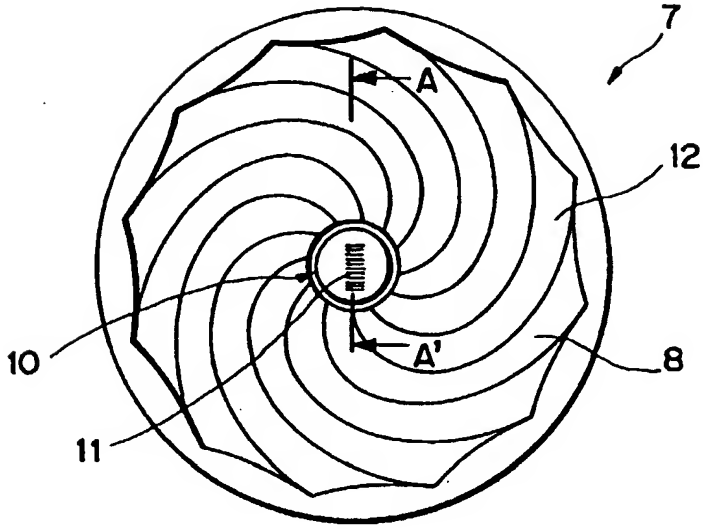


FIG. 4

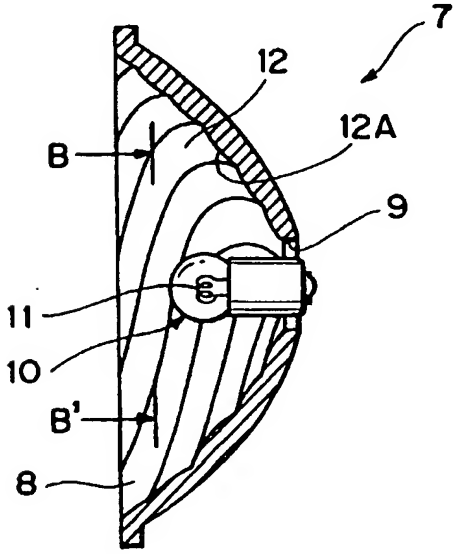


FIG. 5

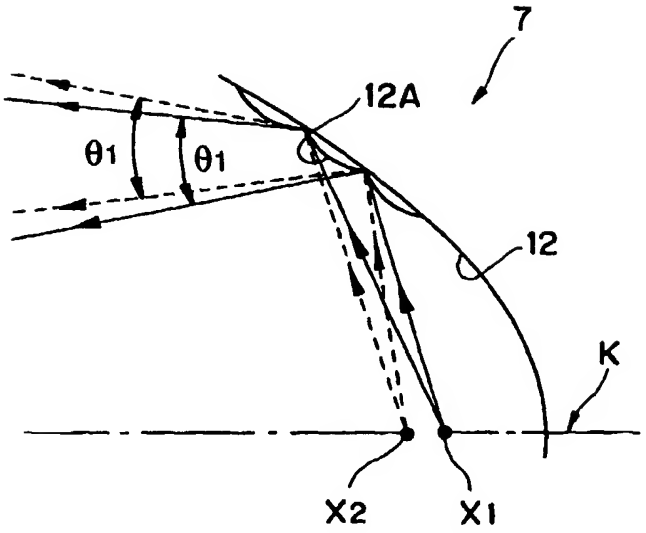


FIG. 6

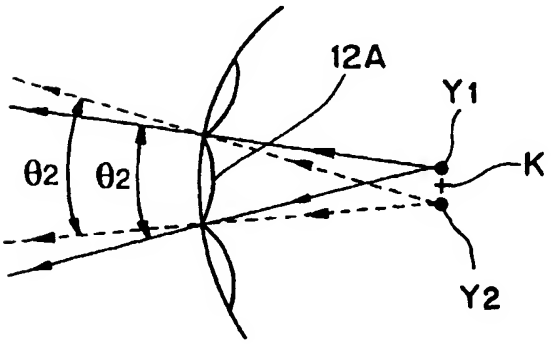


FIG. 7

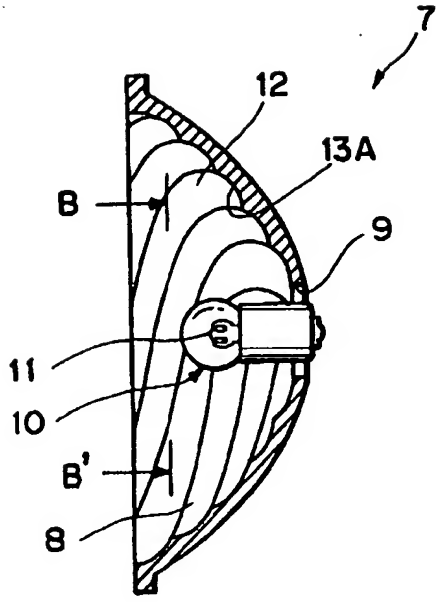


FIG. 8A

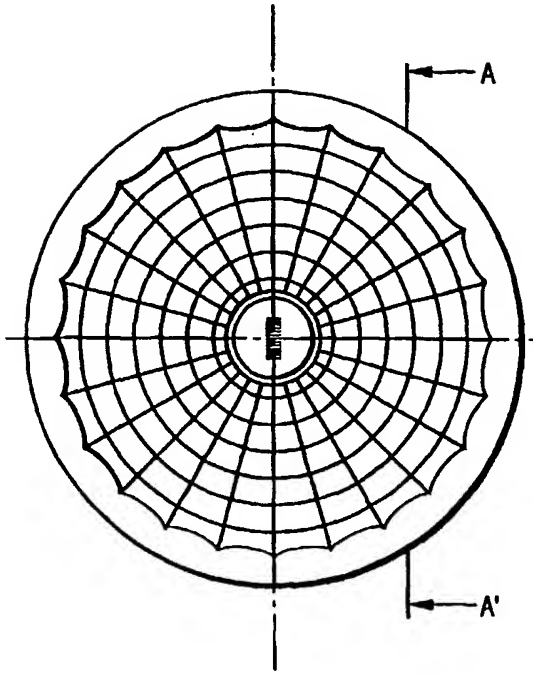


FIG. 8C

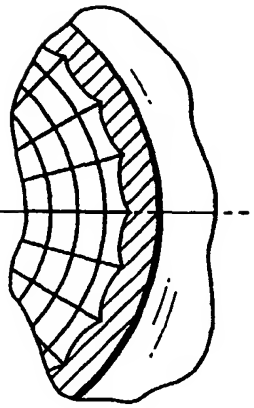


FIG. 8B

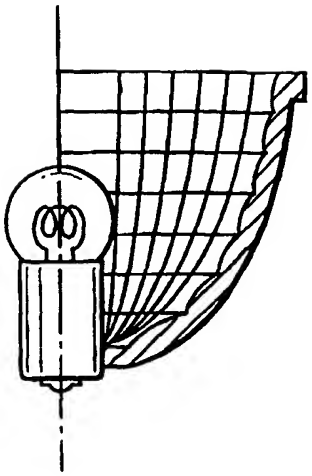


FIG. 9

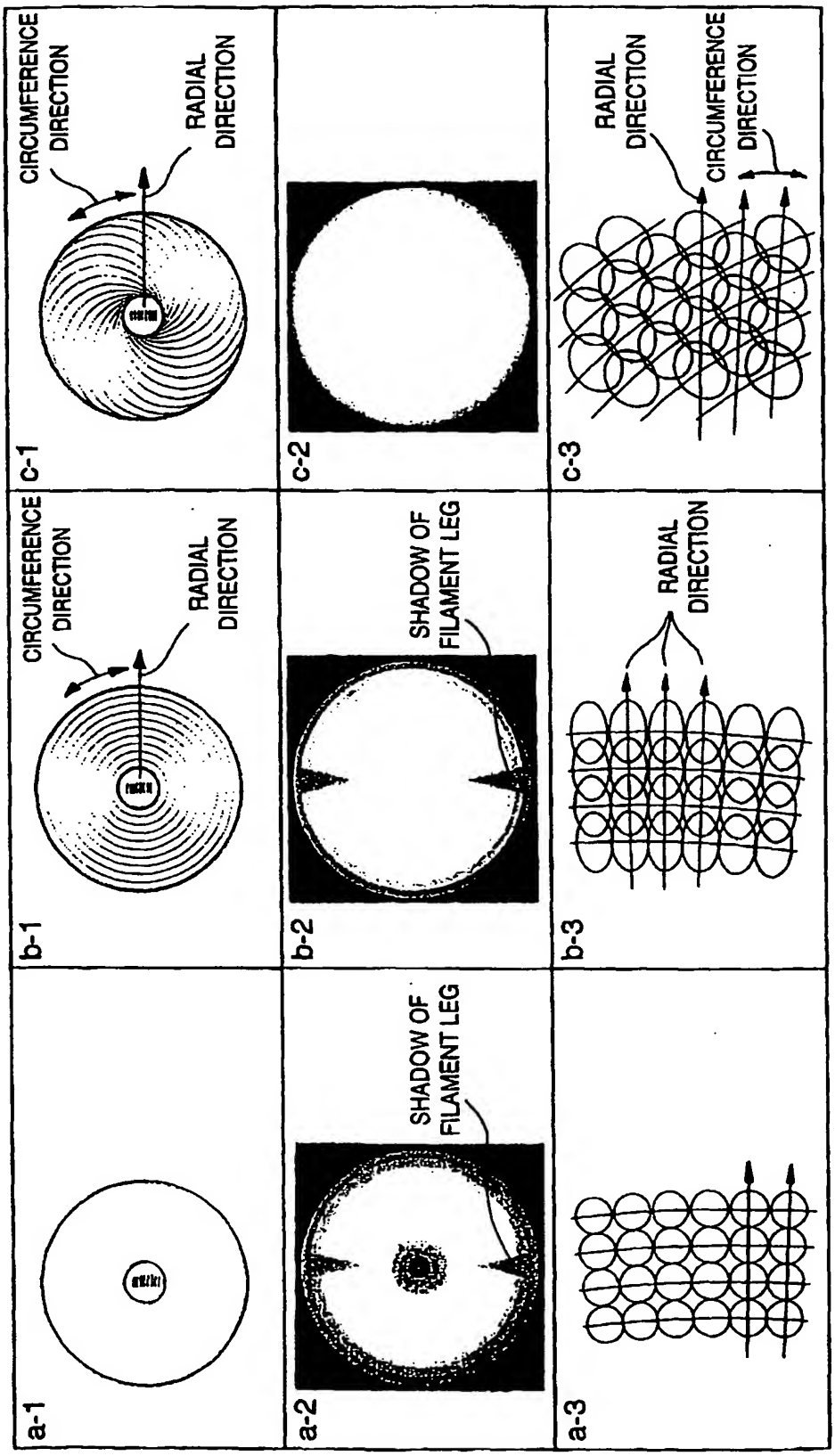

a-1
a-2
a-3
b-1
b-2
b-3
c-1
c-2
c-3
CIRCUMFERENCE DIRECTION
RADIAL DIRECTION
SHADOW OF FILAMENT LEG

FIG. 10

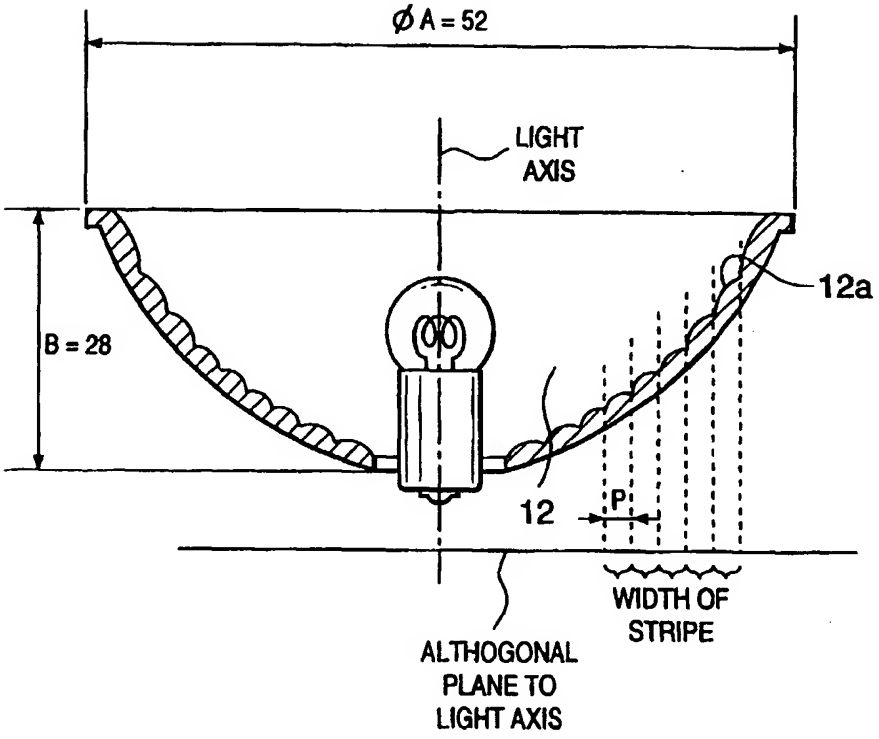

ØA = 52
LIGHT AXIS
B = 28
12a
12
P
WIDTH OF STRIPE
ALTHOGONAL PLANE TO LIGHT AXIS

FIG. 11A

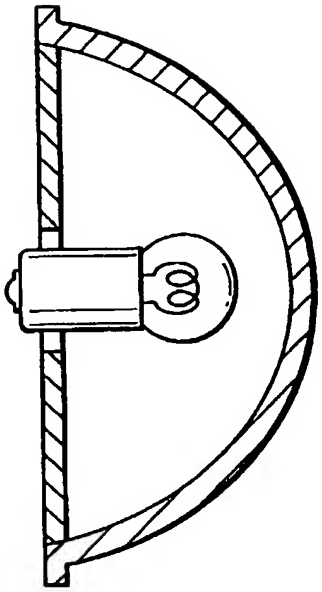


FIG. 11B